Wind Energy

Group - 25

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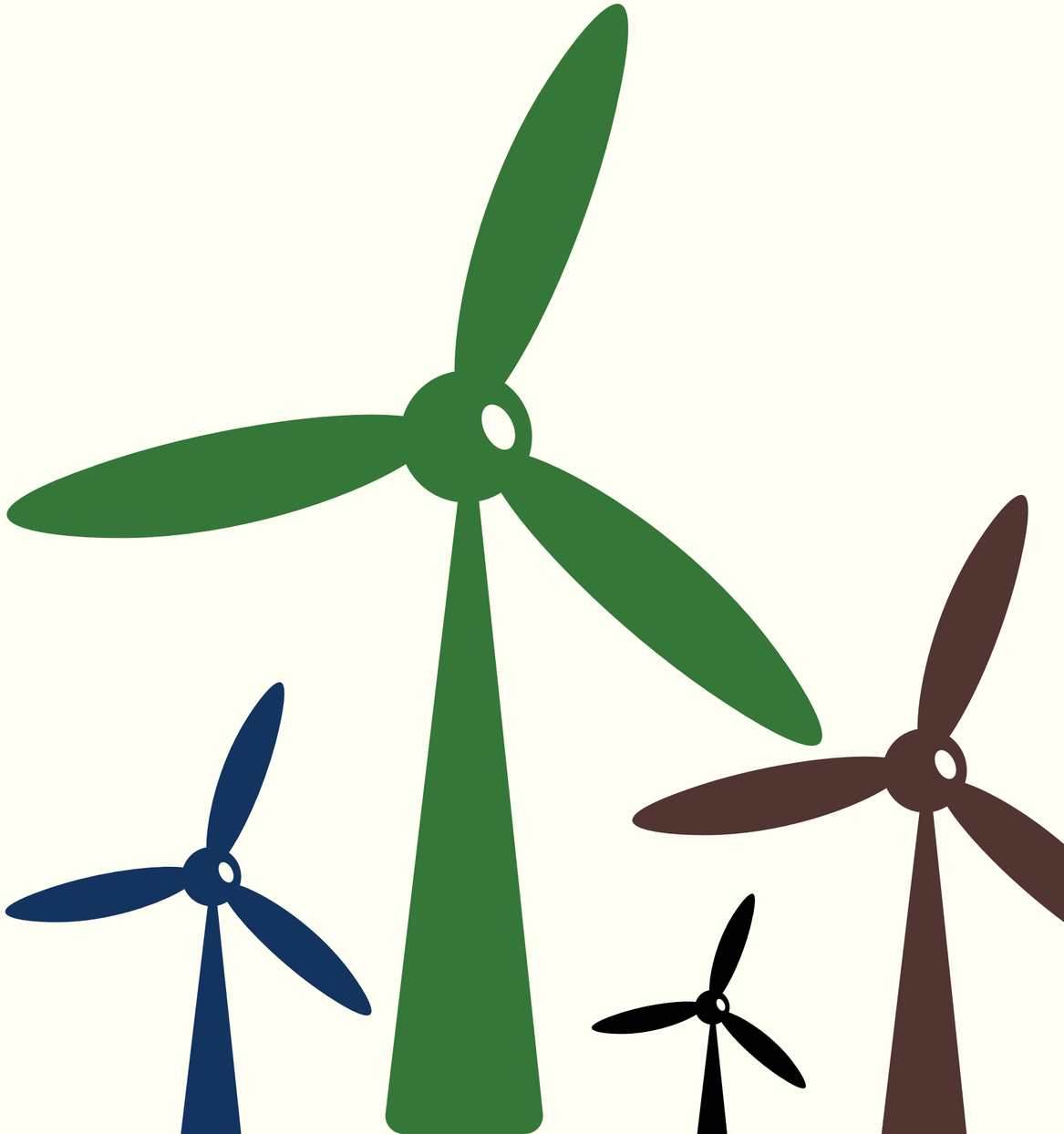
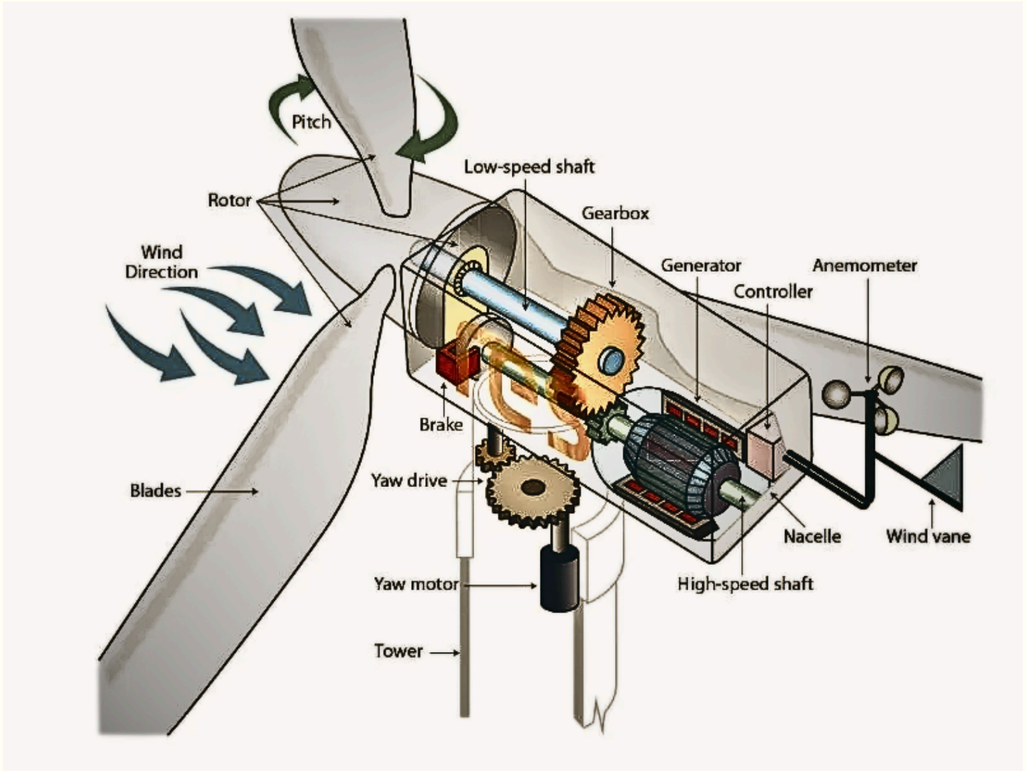


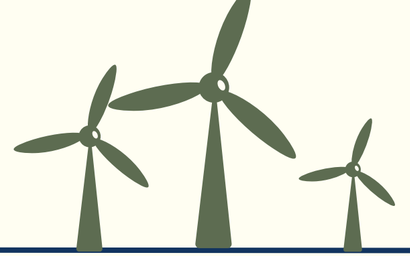
HOW IT WORKS ?

- **In modern wind turbines, wind turns the rotor blades, converting kinetic energy into rotational energy. This energy is then transferred through a shaft to the generator, producing electrical energy.**



https://windmillstech.com/wind-turbine-components/

WORKING PRINCIPLE



- Wind energy is the kinetic energy of moving air. The kinetic energy of a mass m with the velocity v is $E_{\text{kin}} = \frac{1}{2} m v^2$
- The air mass '*m*' can be determined from the air density '*ρ*' and the air volume '*V*' according to $m = \varrho V$
- Power is energy divided by time. We consider a small time, Δ*t*, in which the air particles travel a distance *s* =*v*Δ*t* to flow through. We multiply the distance with the rotor area of the wind turbine, *A*, resulting in a volume of

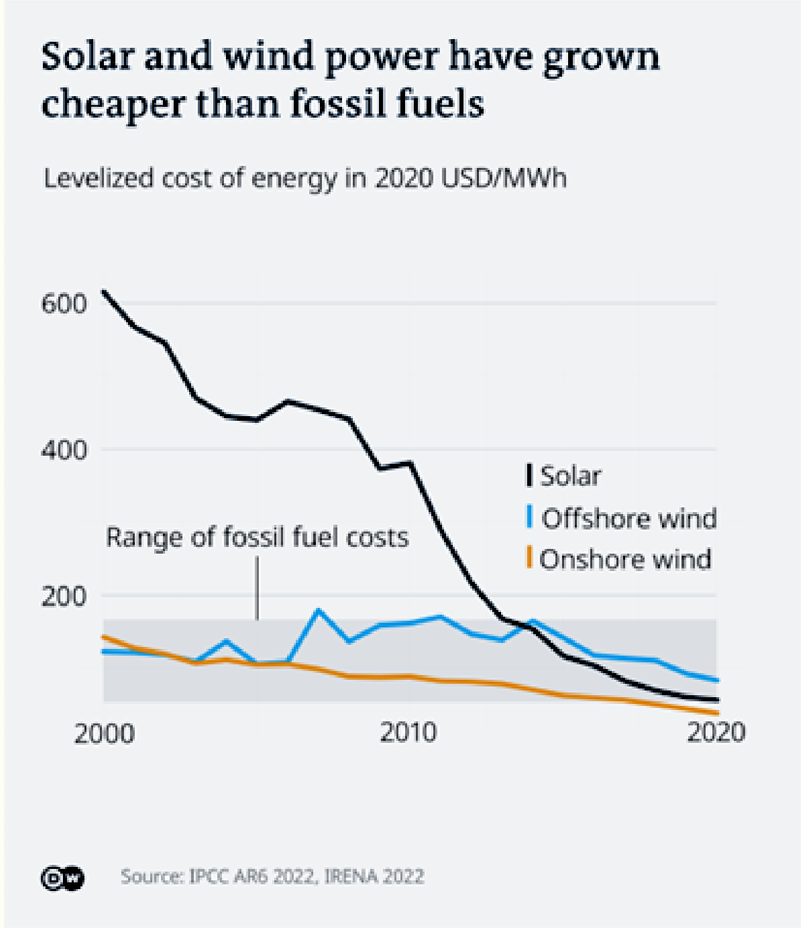
$$\Delta V = A v \Delta t$$

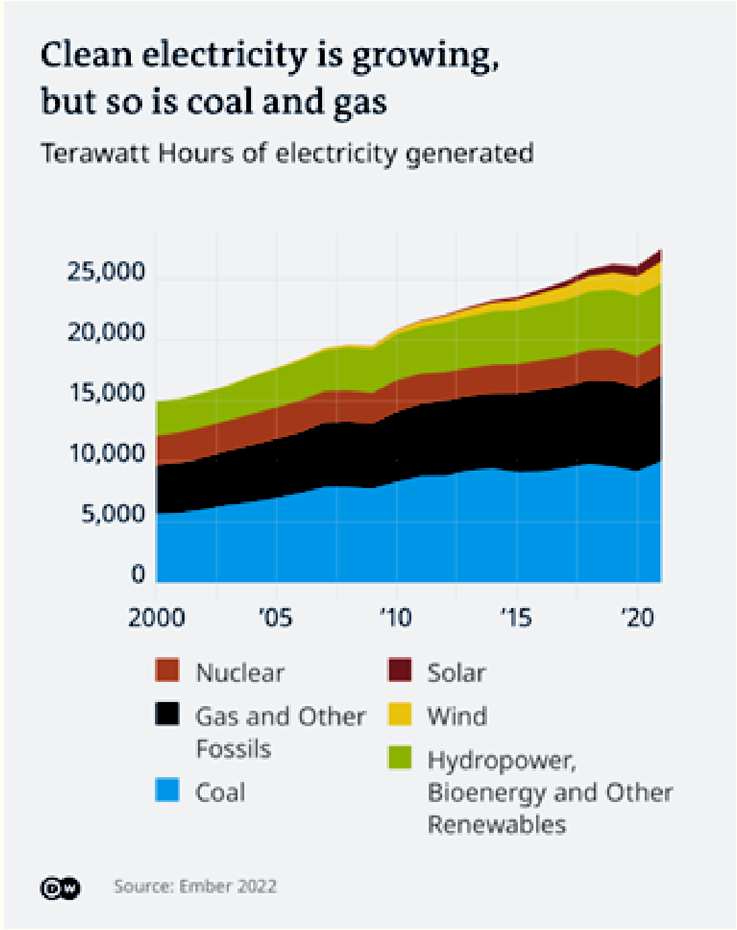
which drives the wind turbine for the small period of time. Then the wind power is given as

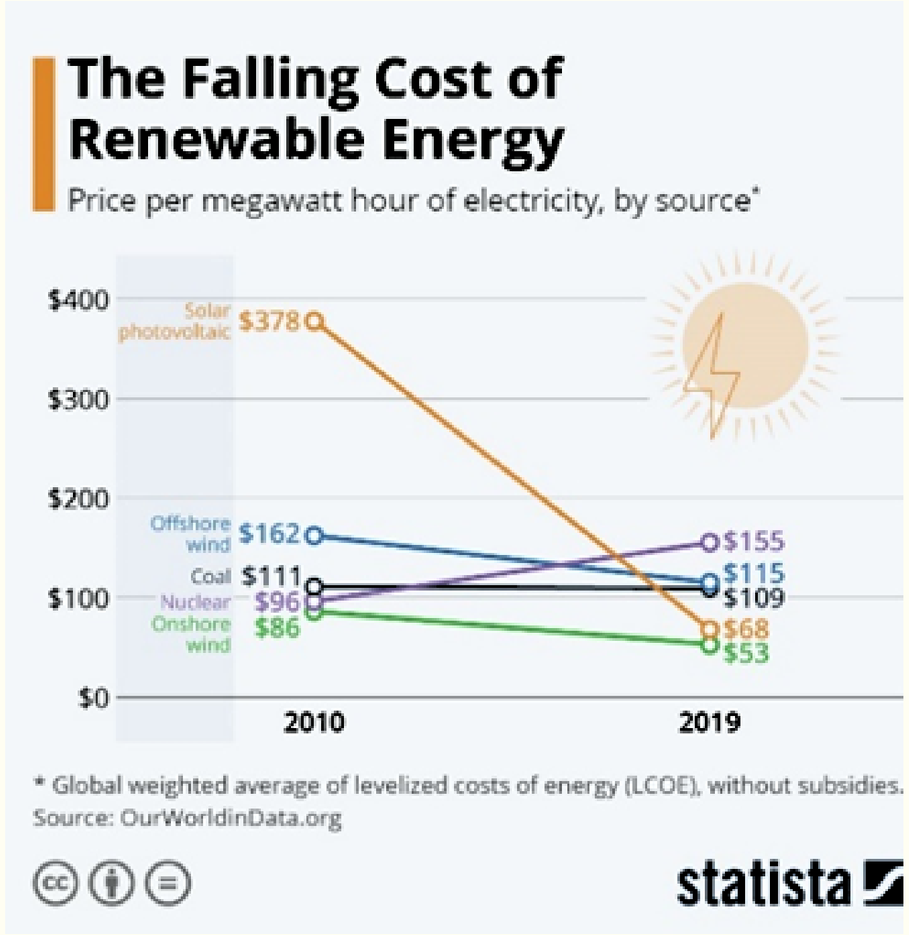
$$P_{\text{wind}} = \frac{E_{\text{kin, wind}}}{\Delta t} = \frac{\Delta V \rho v^2}{2 \Delta t} = \frac{\rho A v^3}{2}$$

https://shorturl.at/bpHO0

WIND ENERGY v/s CONVENTIONAL FUEL







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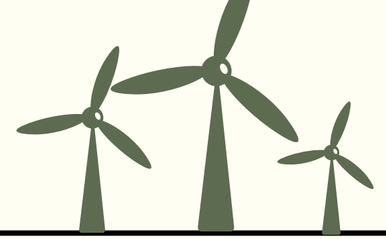
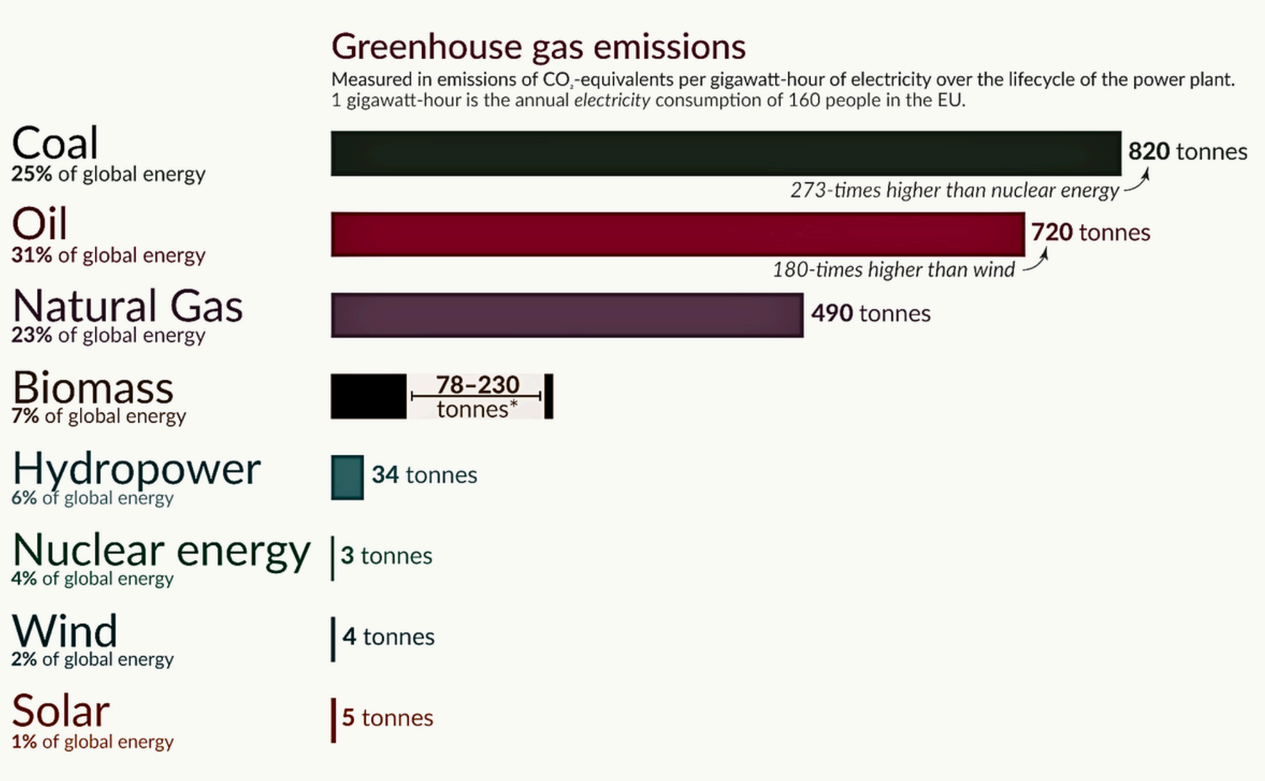
CHALLENGES



- **Location and Land Use**: **Wind turbines require specific wind conditions to operate efficiently, which limits suitable locations for wind farms. Additionally, the construction of wind farms can impact land use and local ecosystems.**
- **Intermittency and Variability**: **Wind is an intermittent and variable energy source, meaning it is not always available or consistent. This variability can make it challenging to integrate wind energy into the grid and ensure a stable power supply.**
- **Offshore Development Challenges**: **Offshore wind farms have the potential to generate large amounts of energy close to densely populated areas. However, offshore development presents unique challenges, such as harsh marine environments, deeper water depths, and increased installation and maintenance costs.**

https://chat.openai.com/c/44e5076d-6852-497d-ad18-7a9872a93019

ENVIRONMENTAL ASPECTS

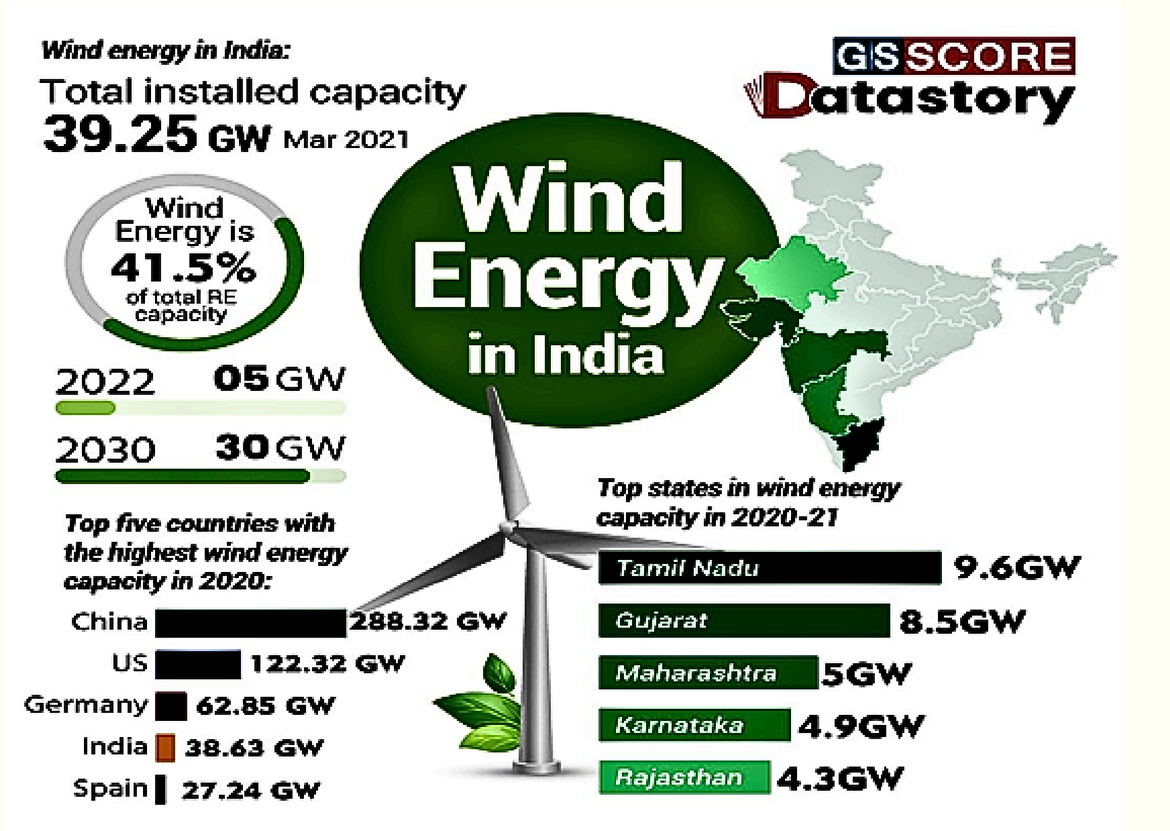


- **By replacing fossil fuel-based power plants, wind energy helps improve air quality by reducing emissions of pollutants such as sulfur dioxide, nitrogen oxides, and particulate matter**
- **Wind energy does not produce toxic pollution which is beneficial for public health.**

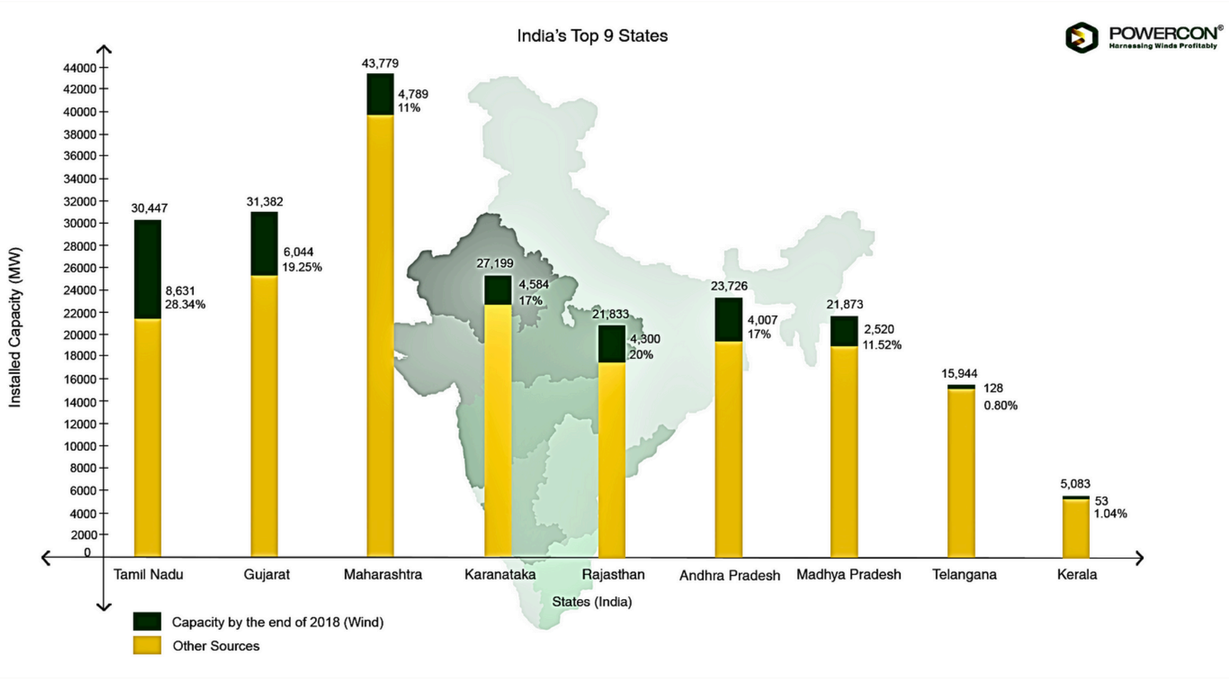
- **Wind farms utilize land for installation, but the surrounding areas can often be used for agriculture or other purposes. Moreover, wind energy has a lower impact on biodiversity compared to fossil fuel extraction**

https://en.wikipedia.org/wiki/Wind_power

INDIAN PERSPECTIVE



https://iasscore.in/data-story



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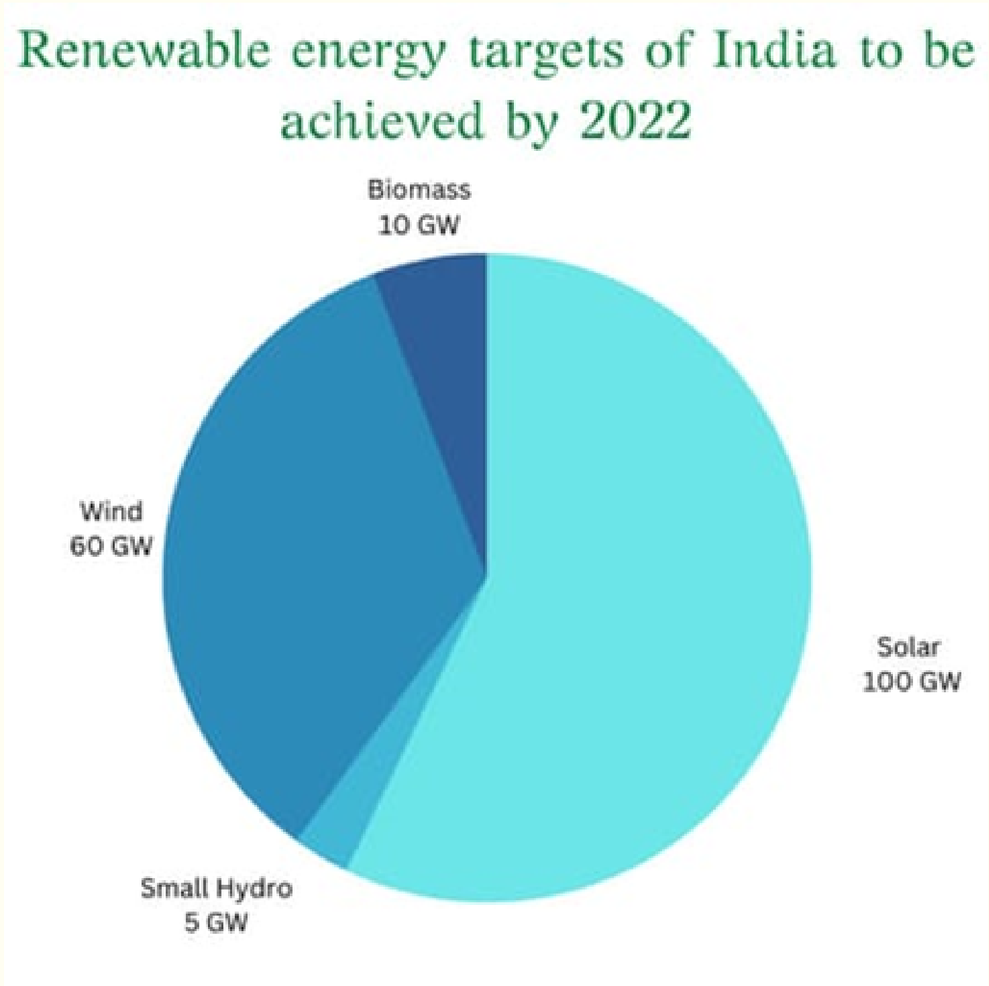
INDIAN PERSPECTIVE



- **National Wind-Solar Hybrid Policy,2018**:

The main objective is to provide a framework for promotion of large grid connected wind-solar PV hybrid systems for optimal and efficient utilization of wind and solar resources, transmission infrastructure and land.

- **National Offshore Wind Energy Policy**:

Objective is to develop offshore wind energy in the Indian Exclusive Economic Zone (EEZ) along the Indian coastline of 7600 km.

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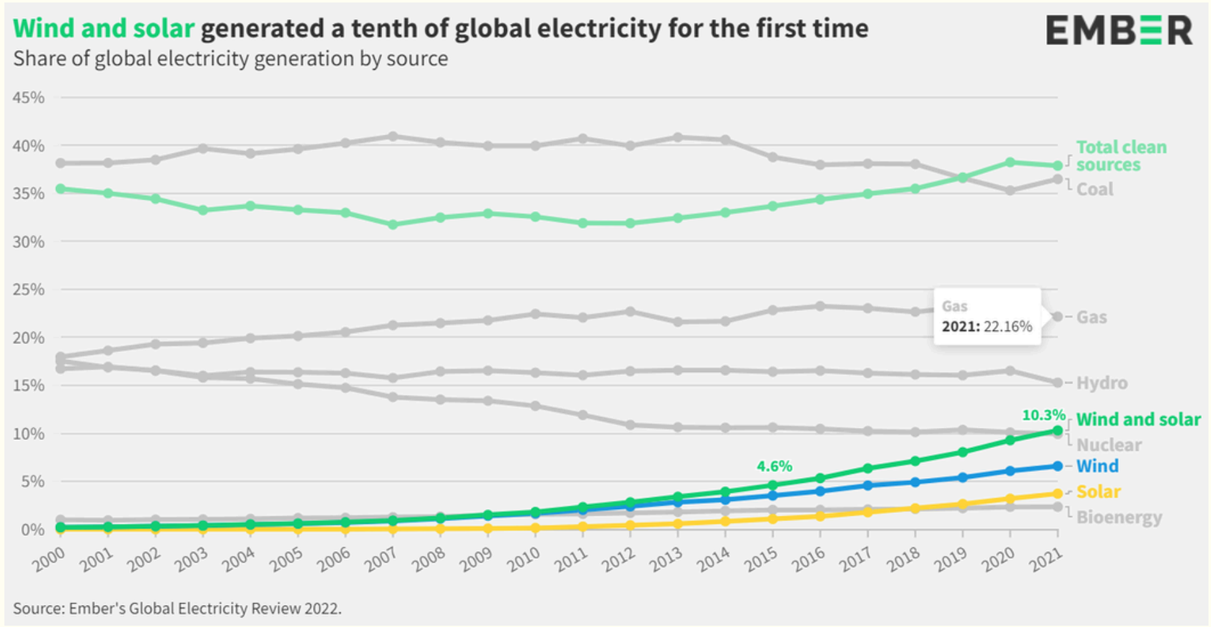
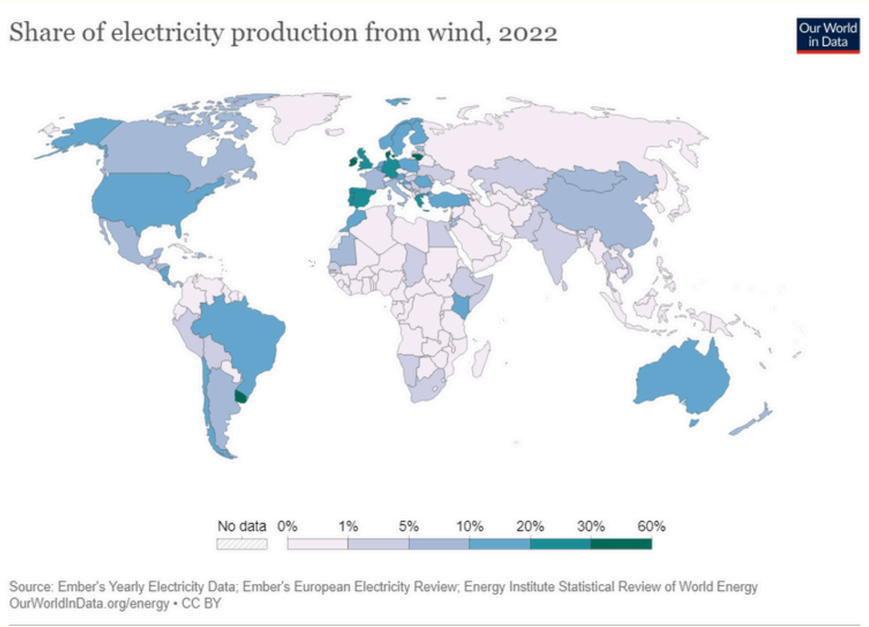
CURRENT SITUATION





- **According to the International Energy Agency (IEA), wind power accounted for about 6% of global electricity generation in 2020. This contribution has been increasing steadily over the past decade as countries invest in expanding their wind energy capacity.**

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FUTURE PROSPECTS

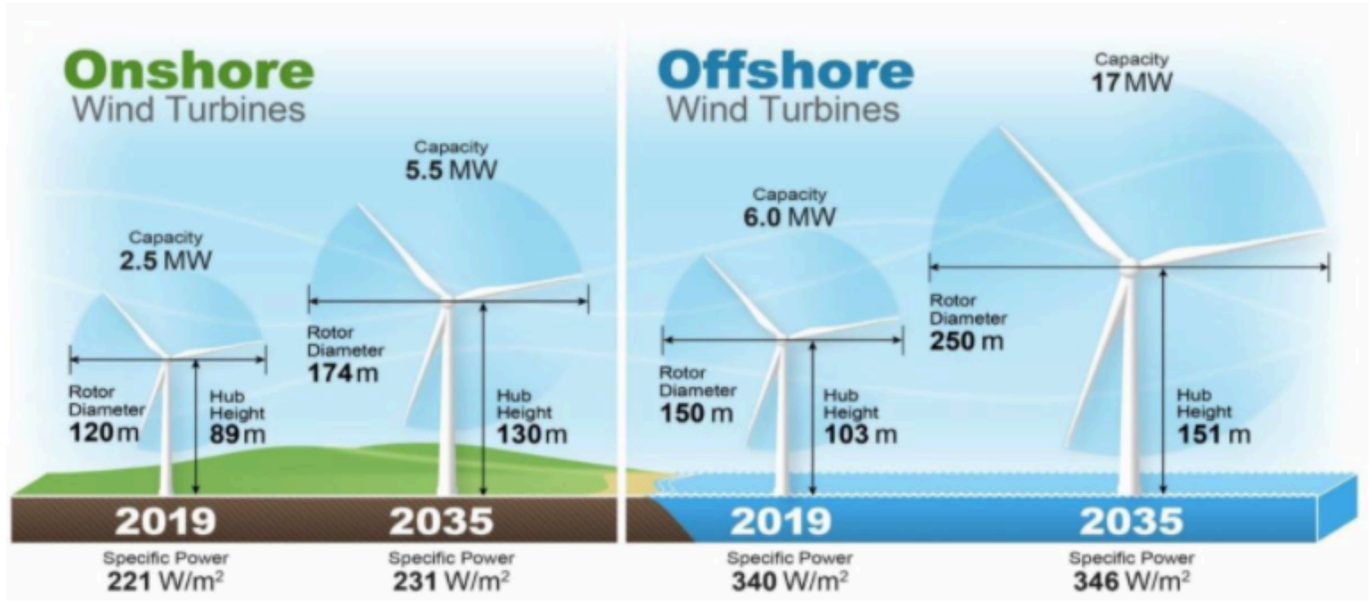

Figure 3. Experts anticipate significant growth in onshore and offshore turbine size

- India has established infrastructure for onshore wind farms but is relatively new to offshore wind energy.
- Ministry of New and Renewable Energy (MNRE) set a medium-term offshore target of 5 GW by 2022 and a long-term target of 30 GW by 2030.

- Gujarat and Tamil Nadu identified as initial states for establishing the first offshore wind energy farms based on preliminary reports.

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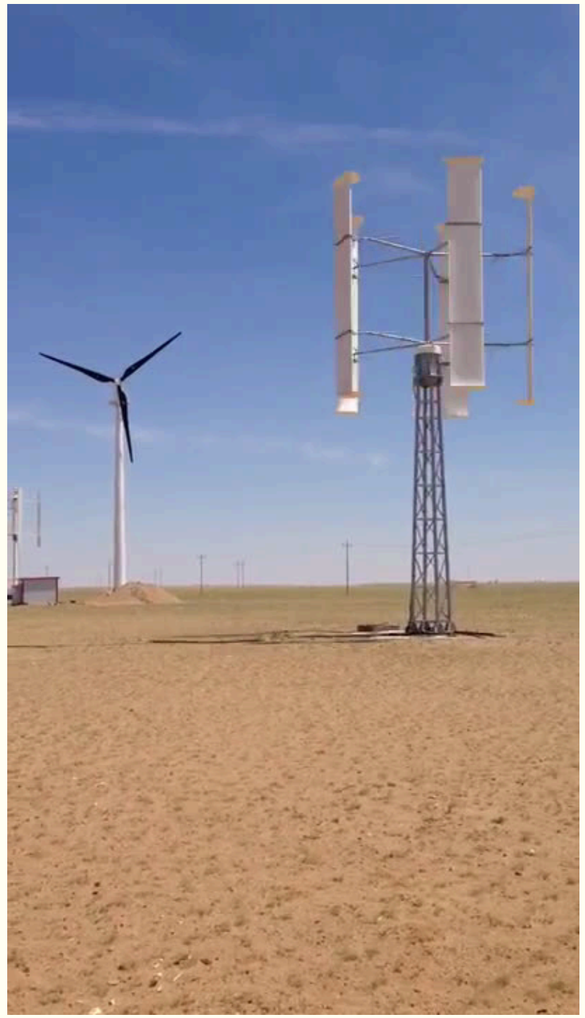
INNOVATION



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Thank You